ISSN 0820-8107

Forestry Canada Forêts Canada

NO. 251

Forestry Canada - Maritimes Region

TECHNICAL NOTE

HOW TO ESTIMATE FUTURE COMPETITION STRESS TO BETTER SPEND HERBICIDE DOLLARS

HIGHLIGHTS

- Competition Index (CI) measures light deprivation
- Simple, fast, cheap, and easy-to-use
- CI can be used to describe growth thresholds
- Practice of releasing overtopped plantations must change
- Herbicide rich sites before planting
- Perceptions of "free-to-grow" are incorrect
- Woody vegetation more serious than herbaceous vegetation
- User must know site type, site history, and harvest methods

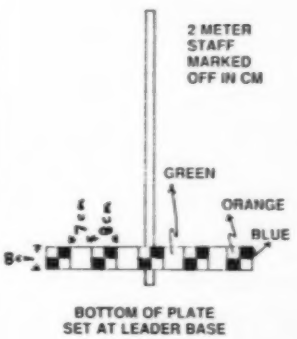

Figure 1

Figure 2

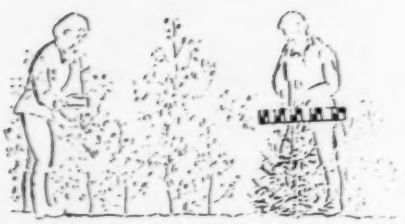

Figure 3

NURSERIES

PLANTATIONS

SILVICULTURE

UTILIZATION

ECONOMICS

TREE IMPROVEMENT

INSECTS AND DISEASES

Forestry Canada - Maritimes Region
P.O. Box 4000, Fredericton, N.B. E3B 5P7
P.O. Box 667, Truro, N.S. B2N 5E5
P.O. Box 190, Charlottetown, P.E.I. C1A 7K2

Cette publication est aussi disponible en français sur demande

91-05454/

METHODS

A research project was initiated in 1984, under the New Brunswick Forestry Research Advisory Committee, to develop a competition index (CI) to determine at what level (threshold) competition detrimentally affects young conifer growth. This index was designed to increase understanding of the possibilities for timing competition control so as to maximize both crop tree growth and the return on investment from intervention against competitor growth.

The Forestry Canada Competition Index (FCCI) method was developed for measuring competition stress by assessing a combination of light interference by completing vegetation and the degree of its overtopping on a developing seedling. The method uses a 2m staff with a horizontal cross member divided into a number of colored squares (Fig 1). This is placed in front and due south of the seedling such that the base of the colored plate is level with the base of the seedling's leader. An observer, 2m due south of the seedling, estimates what percent of the 5 groupings of colored squares can be seen through the intervening vegetation (Figs. 2,3).

The Average of the Percent Squares Seen (APSS) is converted to Percent Squares Not Seen (PSNS) by subtracting APSS from 100. This is coupled with the Mean Height of the Competition (MHtC) and the Height of the Base of the live leader (HtBL) to produce the formula for calculating CI:

$$CI=PSNS*(MHtC-HtBL)$$

If MHtC is less than HtBL then CI=PSNS.

This method can be used in any weather. The field measurements to calculate CI for any seedling require about 90 seconds per seedling. Approximately 100 randomly chosen seedlings, or potential planting spots, per plantation, will characterize most proposed planting blocks. The method can be used to assess sites before seedlings have been planted to determine if preplanting vegetation control is necessary. In this case, the base of the colored plate would be placed approximately 6 cm above ground, to approximate the height of a planted seedling. Then, to calculate CI, the value for HtBL would be 6. The CI should be measured once between mid-July and mid-August to assess whether vegetation control will be necessary in the current year (treatment with VISION is usually done between mid-August and mid-September). The FCCI is powerful because of the strong relationships between measured CI and juvenile conifer seedling growth.

The current practice of basing herbicide release on levels of overtopping by competition is an inefficient use of herbicides. Seedlings in the overtopped condition are already experiencing considerable competition stress and growing below the potential for the site. Threshold levels of competition are much lower than conventional wisdom would suggest. Since volume growth, which is not easily visualized, is affected to a greater extent by competition than is the easily observed height growth, plantations judged by eye-balling to be free-to-grow may actually be suffering from enough competition to significantly decrease growth. Competition stress which severely affects growth rates appears to have to occur for several growth seasons to cause actual mortality. Associated vegetation levels for seedlings (very low CI) which produce an increase in growth (nurse crop function) were not observed.

GUIDELINES FOR DECISION MAKING

Threshold levels for black spruce are generally about 1000 CI units while jack pine and red pine, which are even more shade intolerant, have threshold levels below 500 CI units. We have not yet established threshold levels for such shade-tolerant species as balsam fir and red spruce or for species with intermediate shade tolerance such as white pine.

Rich Sites

For rich sites, it is best to do whatever site preparation is necessary and THEN AWAIT THE EMERGENCE AND EARLY GROWTH OF NON-CROP VEGETATION. Herbicide can then be applied while the competition is in its early stages of development and less herbicide is required. Planting can follow later. If black spruce were to be planted on a fertile site type, which had been mechanically site prepared at least 2 months previous to assessment so that germinating seed and sprouts had partially developed, and average CI levels were 250 units for 100 potential planting spots, then preplanting herbicide application would be called for. It can be theorized that herbaceous or woody vegetation offering 250 units now, will develop into several thousand units by the fall of the planting year (with planting planned for next spring). If preplanting herbicide application is not done now, the black spruce planted next spring, will have to endure higher than threshold levels of competition for most of the planting year because of the explosive growth potential on rich sites.

In general, woody competitors are more detrimental to seedling growth than herbaceous competitors because herbaceous competitors allow some direct sunlight for the seedling in the early part of the season when they are developing from the ground up. In descending order, the competitors in New Brunswick that may be most detrimental to seedling growth, when present in sufficient numbers, would be: raspberry, hardwood sprouts, grass, pin cherry, hardwood seedlings, fireweed and ferns. Grass is a more serious competitor than the measured CI units caused by it would indicate.

If CI assessment, in mid-July, of 100 randomly chosen black spruce seedlings, planted in May, is found to be 500 units, then herbicide treatment should be applied late in the spray season (early September, after the new seedlings are well hardened off), because the next time herbicide can be applied will be next August. If the 500 units of average CI is being caused by raspberry or other woody vegetation, by the time herbicide application is possible next year (after mid-August), these spruce will have experienced competition far in excess of threshold levels due to explosive vegetation development. However, if the 500 units of CI were being caused by golden rod, bracken fern, fireweed or even grass, it can be predicted that next year at this time average competition stress produced by this type of vegetation may not be so much greater than it is now. Herbicide application, which is possible only after the spruce has hardened off in late September, will not deal with the seeds of most herbaceous species which have already been produced and which will re-establish similar competition next year, even if control of this year's herbaceous vegetation could be carried out. The label instructions on VISION suggest the chemical not be applied to planted conifers during the planting year. However, in some jurisdictions this is interpreted to mean that application can commence after most of the growth has finished during the planting year (late summer).

Moderately Poor Sites

On moderately poor sites, vegetation control may be delayed until the late summer or fall of the year after planting, depending on indications as to when threshold levels of competition would be reached. The density of competing vegetation on the site must be considered when judging whether to apply herbicide or not. For example, consider a moderately poor site, harvested within the last year and site prepared at least 2 months previous to assessment, so that sprouts and germinating seed of competitors are already in evidence. Jack pine planting is planned. An average CI of 25 units on 100 potential planting sites was calculated and there were an average of three raspberry sprouts per square meter. It can be theorized that a year from now (next mid-July to mid-August), CI will probably be below threshold limits for pines (500 units). In this situation, herbicide would not be applied. Reassessment would be warranted for next year, to check on competitor development after planting in the spring. If threshold levels of CI were being approached, at reassessment after planting, then herbicide application would be applied to avoid future decreases in growth.

If this same site type, that was to be planted with jack pine, had an average CI of 25 units for 100 potential planting sites, and an average of 50 raspberry sprouts per square meter, if can be theorized that a year from now, CI will be far in excess of threshold levels. In this situation, herbicide site preparation should be done (mid-July to mid-September). The timing would depend on whether seeding grasses are in evidence, since grass competition should be treated before the production of seed, which would germinate the following year. When this pre-planting vegetation control is done, seedlings planted in the following spring do not have to endure CI at several thousand units before herbicide application on hardened off seedlings is possible (in early to mid-September of the planting year).

Poor and Very Poor Sites

On poor sites, competition thresholds may only be reached in the second or third field season. Vegetation control measures should be taken to prevent CI from exceeding threshold levels. It is advisable to treat the competition in the year before threshold levels are reached, rather than to wait until the year when threshold levels would most likely be reached.

On very poor sites, threshold levels of CI may never be reached and herbicide application may be unnecessary.

CONCLUSION

The Forestry Canada Competition Index provides a quick, simple, cheap, and functional method to measure present competition stress on individual planted seedlings or potential planting sites. It uses a broad numerical scale, which does not allow for much subjectivity or personal bias. The method can be used to study and understand the development of competing vegetation on various site types so that predictions can be made about future competition stress. The tool will not predict, it will only measure. Experience and knowledge of competitor vegetation development relative to crop development on various sites will enable foresters to predict the approach of threshold CI levels and avoid them by judicious operational control measures.

P.O. Salonius, K.P. Beaton, and T.S. Murray
May, 1991